

## ***Remedial Action Construction Progress Report***

October 21, 2015

Mr. Larry Stanley  
North Carolina Department of Environment and Natural Resources  
Division of Waste Management  
1646 Mail Service Center  
Raleigh, North Carolina 27699-1646

Re: Quarterly Remedial Action Construction Progress Report, 3<sup>rd</sup> Quarter 2015,  
Seaboard Chemical Corp. and Riverdale Drive Landfill Site, Jamestown, North  
Carolina

Dear Mr. Stanley:

Seaboard Group II and the City of High Point, NC (hereinafter the “Parties”) provide this Remedial Action Construction Progress Report for the former Seaboard Chemical Corporation facility and closed Riverdale Drive Landfill located in Jamestown, NC (collectively hereinafter referred to as the “Site”). The Remedial Action Pre-Construction Report for the physical treatment systems was submitted to North Carolina Department of Environment Quality (NCDEQ)<sup>1</sup> on December 28, 2009. The report was subsequently approved by NCDQ on March 22, 2010. Although the Natural Treatment Systems Remedial Action Pre-Construction Report has not been formally approved by NCDQ, it was submitted on October 25, 2010, and the Parties have included comments on activities associated with that process as well. Collectively these reports are referred to herein as the “Pre-construction Report.”

### **Remedial Construction Work Performed since the Last Progress Report**

During the third quarter of 2015 the Parties implemented certain chemical and mechanical refinements to improve system performance. Following the completion of that construction, the Parties began testing of the system components to determine long-term operating capabilities. During this testing it was determined that, although the system was capable of operating on a sustained basis when treating the deep and shallow groundwater, the amount and type of sludge produced when leachate was incorporated into the flow exceeded the capacity of the existing sludge handling equipment, and caused solids to form and deposit in pipes, pumps and equipment causing excessive system cleanouts and shutdowns.

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<sup>1</sup> NCDEQ is used in this report to refer to the North Carolina Department of Environmental Quality (formally North Carolina Department of Environment and Natural Resources), and collectively the associated Division of Waste Management, Solid Waste Section, Hazardous Waste Section, and the Inactive Hazardous Sites Branch, all of which are involved in the regulatory oversight of this remedial action.

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### **Leachate Problem Investigation and Resolution**

Because the system experienced difficulties when processing leachate the Parties retained the services of Hazen and Sawyer of Raleigh NC to conduct on-site testing to evaluate chemical and mechanical options to address this problem. After they completed their work they made recommendations as to changes that could be made to the system (chemical and mechanical) to address the leachate treatment problem.

Hazen and Sawyer moved a mobile laboratory onsite in mid-September and ran tests on all of the groundwater and leachate sources. After completing their tests, they published a report (copy attached) which recommended the installation of a small clarifier and additional sludge handling equipment, and a change in the treatment chemistry to use lime and ferric chloride (or ferric sulfate) to soften and stabilize the water and remove the sludge component at a point where it will not foul the process.

Hazen and Sawyer confirmed that leachate characteristics are significantly different those of the shallow and deep groundwater. This is due to the high levels of CO<sub>2</sub> and biological matter present in the leachate. When incorporated into the process flow the amount and characteristics of the sludge generated in the process overwhelms the capacity of the existing sludge handling equipment. This causes system shutdowns and equipment fouling.

### **Explanation of Flow Modifications**

The Parties met on October 1, 2015, and approved the design engineering of a clarifier and sludge processing equipment needed to manage the precipitated sludge generated by all flow components, including leachate, before it enters the remaining treatment processes. After this modification is complete, flow from all sources will be sent first to a clarifier before any other processing. At the clarifier lime (400 mg/l) and ferric chloride (140 mg/l) will be used to precipitate and stabilize the sludge forming components before the flow is returned to the existing treatment process at the aeration tank in the filter building. The sludge generated will be concentrated in sludge thickening equipment and the resulting water will be returned to the clarifier inlet. The sludge will be handled as it is presently handled at the landfill. The stabilized flow will enter the filter building and flow into the existing system at the inlet aeration tank. From there it will flow into an equalization tank, then through the existing pressure filter system and air stripper before entering the effluent treatment system at the settling vat. Backwash water from the pressure filters will be sent to a storage tank which will return it to the clarifier inlet.

From the air stripper it will be pumped through a set of 50 micron bag filters and either sent directly to the effluent holding tanks and the phytoremediation system, or through a 1-micron filter and then through an AOP<sup>+</sup> unit. Therefore, the flow, after the clarifier, remains identical to that described in the Construction Completion Report. The only thing the clarifier adds is an initial sludge removal process to stabilize the water and prevent fouling of downstream equipment. An incidental benefit that results from the modification is that it appears that the clarifier effluent will significantly decrease loading on the downstream equipment, reduce the alkalinity and, therefore, reduce the amount of downstream chemicals added to the system. In addition, the lower solids in the downstream system

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should extend the filter run times and potentially improve the removal efficiency of those components. A construction schedule for the modifications is attached.

Please contact Mr. Gary D. Babb, P.G. (919-325-0696) or James C. LaRue (210-263-7580) if there are any questions or comments. Please direct correspondence related to this matter to:

Gary D. Babb, P.G.

Seaboard Group II and City of High Point

c/o Babb & Associates, P.A.

P.O. Box 37697

Raleigh, NC 27627.

Communications via electronic mail should be directed to [gbabb@nc.rr.com](mailto:gbabb@nc.rr.com) and [jlalrue@swenv.com](mailto:jlalrue@swenv.com).

Respectfully,

Seaboard Group II and City of High Point

The image shows two handwritten signatures in black ink. The signature on the left is for James C. LaRue, appearing as a stylized, cursive 'JCL'. The signature on the right is for Gary D. Babb, appearing as 'Gary D. Babb' in a more formal cursive script.

James C. LaRue  
Seaboard Group II

Gary D. Babb, P.G.  
City of High Point

Attachment - Project Schedule

cc Dave Nutt, Esq. - Seaboard Trustee  
Steve Anastos - Seaboard Trustee  
Jeffrey Moore - City of High Point Trustee  
Randy Smith - Financial Trustee  
Terry Hauk - City of High Point  
Jackie Drummond – NCDENR Solid Waste

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### **PROJECT SCHEDULE**

#### **2015-2016**

October-December	Prepare engineering plans, obtain building permit(s), issue RFPs, issue contracts and order parts.  Continue bioaugmentation study of 1,4-dioxane reducing bacteria native to site soils.
January-April	Install system modifications, modify draft Construction Completion Report to include clarifier system
May-June	Test system operations and finalize the process chemistry.

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### **PROPOSED CONSTRUCTION SCHEDULE**

<b><u>DATE</u></b>	<b><u>ITEM</u></b>
10/8-11/9	CIVIL, ELECTRICAL, & STRUCTURAL DESIGN
11/9-11/3	SUBMITTAL OF PERMITS AND RELEASE FOR BIDS
11/30-1/4	RECEIVE BIDS & REVIEW
12/7-1/11	RECEIVE PERMITS
12/15	COMMITTEE VOTE
12/16-12/8	ORDER EQUIPMENT & AWARD BIDS
1/4-1/15	CLEAR SITE, GRUB, & GRADE (WEATHER PERMITTING)
1/4-1/15	RE-PIPE LS-1
1/18-1/29	POUR CONCRETE SLABS AND TANK (WEATHER PERMITTING)
2/1-2/19	INSTALL YARD PIPING & PUMPS
2/22-3/4	INSTALL ELECTRICAL WIRING
3/7-3/11	LIME & FERRIC DELIVERY/SETUP
3/21-3/25	SLUDGE HANDLING DELIVERY/SETUP
3/28-4/8	PROGRAMMING INTEGRATION
4/18-4/22	CLARIFIER DELIVERY/SETUP
4/25-4/29	SYSTEM TESTING & PERMIT CLOSEOUT



## **Remedial Action Construction Progress Report**

# **Hazen** *Memorandum*

September 28, 2015

To: Seaboard Group II & The City of High Point, NC  
From: Gary Iversen, PE, Dr. Z. Michael Wang, PhD, PE, Hazen and Sawyer  
Re: **Jamestown Landfill Leachate Treatment System  
Treatment Process Testing**



### **Introduction & Existing Process Description**

The Seaboard Group II & The City of High Point, NC jointly operate a leachate collection and treatment system located on the Jamestown, NC landfill site.

The existing treatment plant was constructed approximately two years ago and provides treatment for water obtained from four different wells. The wells are strategically located to provide a hydraulic barrier and prevent groundwater migration off the landfill site.

The treatment strategy was designed to provide primary treatment to sequester dissolved solids and remove turbidity using garnet media pressure filters that are operated in a direct filtration mode. As a consequence of this treatment strategy, the water is unstable for calcium and solids can easily precipitate out causing short filter runs and operational issues in the downstream UV treatment components.

The treated water contains elevated levels of 1,4-dioxane an organic solvent, and additional treatment is provided on site for the dioxane removal. EPA has classified 1,4-dioxane as a Group B2, probable human carcinogen.

The 1,4-dioxane is not air strippable, and does not absorb on activated carbon, however it can be destroyed by UV light. Treated water containing the 1,4-dioxane is pumped to a controlled pilot study area where the water is used for irrigation of trees. The water is taken up by the trees to the leaves where the dioxane evaporates into the atmosphere along with the water by transpiration. After the dioxane enters the atmosphere it is exposed to UV light and is rapidly broken down into harmless components.

As a backup alternative for 1,4-dioxane removal by the irrigated trees, a UV destruct system is provided in the treatment plant. This system operates on 480 Volt, 400 amp, 3-phase power and consequently is expensive to operate. This UV dioxane destruct system is sensitive to solids precipitation and must be continuously monitored by operating personnel when in use.

To address the issues of solids precipitation within the existing treatment system, Hazen and Sawyer was retained to evaluate treatment options to reduce or eliminate solids precipitation within the existing treatment plant.

Hazen and Sawyer • 4011 Westchase Boulevard, Suite 500 • Raleigh, NC 27607

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### **Bench Scale Testing**

Hazen and Sawyer recently conducted process testing at the Seaboard & High Point leachate treatment system in Jamestown, NC from September 11<sup>th</sup> through September 19<sup>th</sup>.

One of the primary issues of the solids precipitation were the short filter runs. In some cases the high levels of solids resulted in filter runs of 1 hour or less, effectively shutting down the treatment process. Over time, it appears that calcium precipitation in the pipelines from the well to the treatment process and within the process components, and the filtered water piping from the filters to the tree irrigation area is causing increasing headloss. Eventually, the deposition of calcium will cause higher and higher head losses requiring that all the piping be replaced.

To provide a treatment process to remove the solids and stabilize calcium so that precipitation will be either significantly reduced or eliminated, it appears that the best alternative would be to provide primary clarification that includes precipitative softening and coagulation to reduce turbidity.

Bench-scale testing was performed using Phipps and Bird 6-gang mixers, with 2-liter square jars equipped with sample taps located at a fixed depth. Prepared chemical stock solutions were added to the test jars using biological syringes for accuracy.

Typically, bench scale jar testing procedures for flocculation and clarification basins are developed using the surface area loading rates and the hydraulic detention times in those basins, and the mixing energy is determined by trial and error. Sedimentation settling time is determined based on surface area loading rate (plant flow/basin surface area). The equation used to convert the settling rates in the 2-liter jars to the full-scale basin loading rate to establish similitude with a full scale plant is:

$$(\text{Settling rate in cm/min})(1 \text{ ft}/30.48 \text{ cm})(1440 \text{ min/day})(7.48 \text{ gal/cf}) = \text{gpd/sf}$$

However, since the goal of this testing was to determine if primary clarification could provide for solids removal and calcium stabilization a jar test strategy was used to duplicate the treatment of an existing clarifier previously modeled at another landfill leachate treatment site.

To simulate the full-scale plant in the jars, various mixing conditions were tested, and settled water results from the jar tests were compared to the settled water from the clarifier until a good match was obtained.

The mixing times and energies selected that simulate an existing full-scale leachate treatment clarifier are presented in Table 1.



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Table 1 – Mixing Energy

Treatment Stage	Mixing	Test Settings
Rapid Mix	RPM	100
	Duration (sec)	60
1 <sup>st</sup> Stage Flocculation	RPM	20
	Duration (min)	21
Settling Time (min)		10

As shown in **Table 1**, the mixing energies needed to approximate the full scale plant are presented. The flocculation time of 21 minutes was determined based on the volume of the center skirt divided by the flow rate, and the settling time is based on the surface area loading rate of 0.5 gpm/sf.

### Basic Leachate Raw Water Quality

Raw water samples were collected from all four individual wells and then blended in a ratio to reflect their approximate flow rates to produce the test water. The raw water was collected in 6-gallon jugs to be used for the bench scale testing and then blended to duplicate their relative flow rates. The blend ratios are presented in Table 2.

Table 2 - Blend Ratios

<u>Well #</u>	<u>Designation</u>	<u>Flow</u>	<u>%</u>
Well #1	PWDR-1	20 gpm	44%
Well #2	RW-S1S	5 gpm	11%
Well #3	LCMT-LS1	15 gpm	33%
Well #4	RW-LS1	5 gpm	11%

The combined/blended samples were analyzed to determine basic water quality parameters. The results are shown in Table 3.

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**Table 3**  
**Leachate Water Quality**

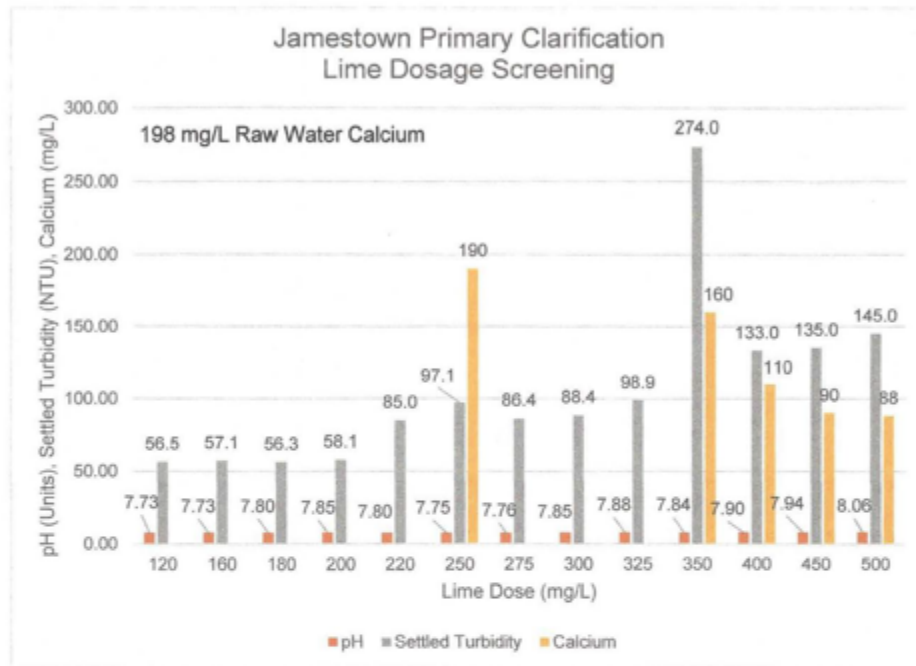
Analysis	9/15	9/16
pH (units)	6.89	6.83
Calcium (mg/L)	198	168
Alkalinity (mg/L)	1020	920
Temperature (°C)	22	20.5
Turbidity (NTU)	150	74

As shown, these water quality values represent water samples collected from combined/blended samples from the individual wells.

### Softening

Accordingly, the test jars were prepared with blended well water to determine the range of lime doses that would be needed for softening and to evaluate the pH effects of the lime dosages. The results are presented in **Figure 1**.

**Figure 1  
Lime Dosage Screening**

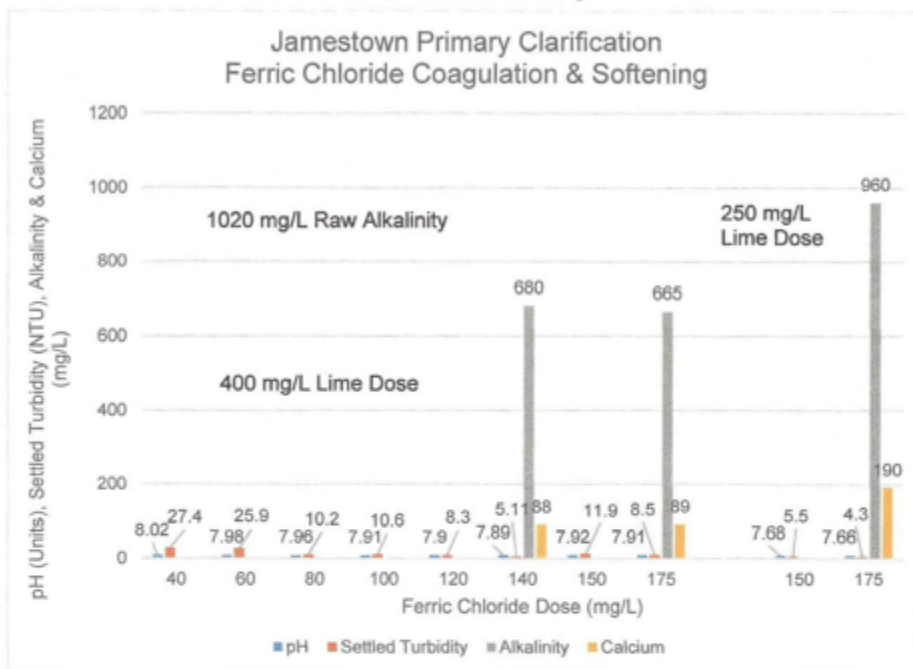


As shown, because the alkalinity was high at 1020 mg/L, lime doses of 250 mg/L or higher were necessary to raise pH sufficiently to initiate calcium precipitation. At a dose of 400 mg/L dissolved calcium was reduced by approximately 45% with a pH of 7.9. Higher doses were tested and addition calcium was removed, however, it was likely that the 400 mg/L lime dose was sufficient to stabilize calcium in the water. Settled water turbidity was high over the range of lime doses tested and would not be acceptable. At the 400 mg/L lime dose settled water turbidity was 133 NTU, indicating that softening cannot be used unless settled turbidity can be reduced.

Accordingly, ferric chloride and ferric sulfate coagulants were tested to determine their performance in helping to reduce turbidity and alkalinity. Samples were obtained for testing from Kemira, a manufacturer of ferric chloride (Kemira 67%) and ferric sulfate (Kemira, 65%). These products are NSF approved for drinking water treatment.

The results of the ferric chloride testing are presented in **Figure 2**.

Figure 2  
Ferric Chloride Screening



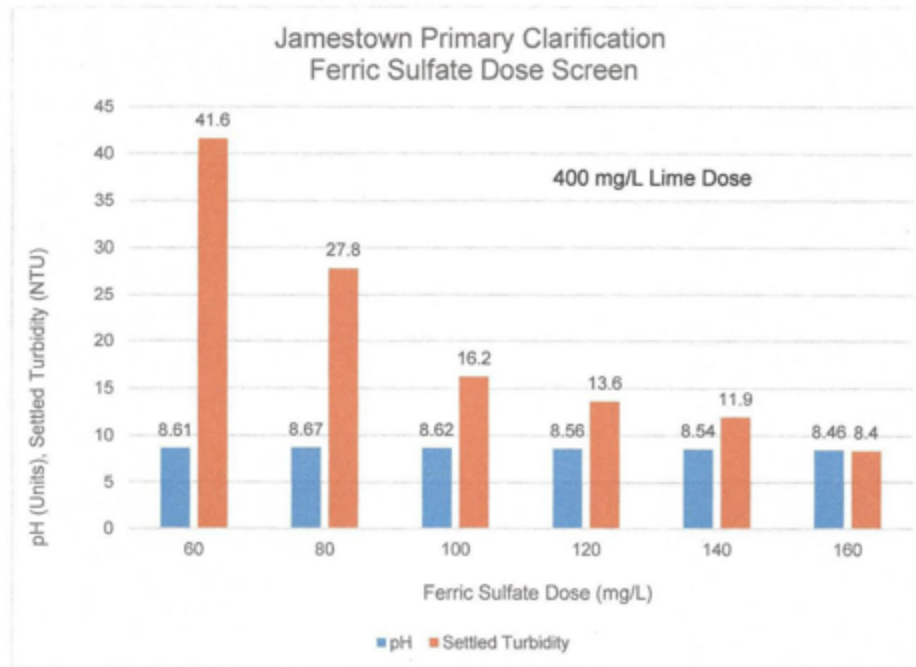
As shown ferric chloride was tested over a range of doses, from 40 mg/L to 175 mg/L to determine performance. Lime was also dosed at the same time at a dose of 400 mg/L for 8 of the test jars. The other two test jars shown on the right side of the graph show ferric chloride doses of 150 and 175 mg/L, but with a lime dose of only 250 mg/L.

The best ferric chloride performance with a lime dose of 400 mg/L was obtained with a 140 mg/L ferric dose, providing a settled water turbidity of 5.1 NTU.

The best ferric chloride performance with a lime dose of 250 mg/L was obtained with both ferric doses tested. Ferric chloride doses of 150 and 175 mg/L provided settled water turbidity values of 5.5 and 4.3 NTU, respectively.

Ferric sulfate was tested with a 400 mg/L lime dose at ferric doses of 60 to 160 mg/L. The ferric sulfate test results are presented in Figure 3.

Figure 3  
Ferric Sulfate Dose Screening



As shown, ferric sulfate also showed good turbidity reductions with the lowest settled water turbidity of 8.4 NTU at a dose of 160 mg/L. The 160 mg/L dose provided an alkalinity of 580 mg/L and calcium of 160 mg/L. Aeration prior to ferric sulfate addition provided a good reduction in alkalinity but appears to only provide a 20% reduction in calcium levels.

Additional testing was conducted using ferric chloride with and without air stripping and with and without chlorine as an oxidant to evaluate if performance could be improved. The results are presented in Table 4.

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**Table 4**  
**Additional Testing**

Chemical Doses	No Aeration			Aerated		
Chlorine (mg/L)	10	-	-	10	-	-
Lime (mg/L)	400	400	500	400	400	500
Ferric Chloride (mg/L)	140	140	140	140	140	140
pH (Units)	7.85	7.86	8.06	7.88	7.91	8.14
Turbidity (NTU)	12.4	9.26	13.3	18.5	16.5	17.0
Alkalinity (mg/L)	680	720	650			
Calcium (mg/L)	140	116	96			

As shown, when chlorine is added or when the water is aerated prior to chemical dosing the settled water turbidity levels increase. The chlorine dosing also appears to interfere with calcium precipitation. Based on the results of this testing raw water should not be aerated prior to chemical dosing, and chlorine should not be used.

To determine if the water was stable and that no additional solids would precipitate, test water that was treated using a 400 mg/L lime dose and a 140 mg/L ferric chloride dose was filtered, and then vigorously aerated and held overnight to determine if additional solids would precipitate. The next day the aerated sample was observed to have no sediments, indicating that the water was stable and there were no precipitates present.

### Existing Solids Handling

Currently filter backwash solids and precipitated solids from the existing process basins are treated using grade level slow sand filters. After the solids are placed on the sand filter and the water drains, the solids and some of the sand is manually shoveled for transport to the landfill. Since some of the sand filter material is also removed the sand is periodically replaced as needed to maintain the slow sand filter. The high levels of solids and the frequency of filter backwashes can generally be managed, however, in the cold weather months, the wet sand freezes and water can no longer drain from the solids, effectively taking the sand filter out of service leaving no alternative for solids handling.

### Recommendations

Based on the results of the bench scale testing and jar test mixing energy and settling strategy used to duplicate an existing full scale clarifier it appears that a conventional circular clarifier can be used to provide for solids removal and calcium stabilization. The recommended clarifier should be designed for gravity settling and equipped with continuous sludge removal and a center mixing cone providing approximately 20 minutes of flocculation time at a design flow of 100 gpm. The mixing/flocculation zone should be equipped with a variable speed drive mixer to allow for changes in mixing energy to optimize floc formation and settled water turbidity performance.

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The design flow rate is slightly higher than the calculated actual flows consisting of the combined flow rate of the four wells at 50 gpm, plus gravity thickener supernatant recycle that includes the clarifier underflow and the filter backwash water estimated at 25 gpm. The additional 25 gpm in capacity will allow for flow surges and additional backwash water if needed.

The proposed clarifier should have a side water depth of 12 to 15 feet and a basin area sufficient to provide a surface area loading rate of 0.5 gpm/sf at the design flow of 100 gpm. This translates to a minimum diameter of 16 feet, however, this small size may require custom fabrication and a larger stock unit may be more economical. A basin that is larger than actually needed may be beneficial in that the lower surface area loading rate would provide lower settled water turbidity.

It is expected that this strategy will provide good treatment and allow for calcium precipitation and stabilization, and will allow solids to precipitate prior to the existing treatment process significantly extend filter run times.

Liquid hydrated lime and ferric chloride are the recommended treatment chemicals.

Preliminary calculations of solids that will be generated in the clarification process are estimated at approximately 500 lb of dry solids per day. At a 2% concentration these solids will result in a volume of approximately 3000 gallons per day. To handle these additional precipitated solids and also treat the filter backwash water on a year round basis, solids handling equipment is recommended.

A gravity thickener should be provided for the first step in solids dewatering. The thickener would also act as an equalization basin for filter backwash water. The solids from the gravity thickener could be further dewatered to the desired concentration using a small variable flow, variable speed centrifuge. Supernatant from the thickener would be recycled to head of the proposed clarifier using a variable speed pump to maintain constant flows in the clarifier.

Centrate from the centrifuge would also be recycled to the thickener, and in turn recycled to head of the clarifier. In this way, centrate would be diluted by the underflow water from the clarifier (to the thickener) and would be less likely to cause an upset.

The dewatered sludge solids would be disposed of on the landfill site as is currently permitted.

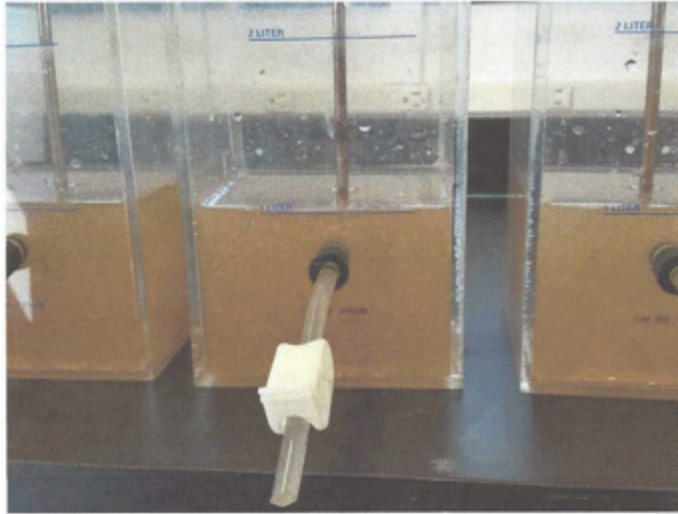


## ***Remedial Action Construction Progress Report***

**Hazen**

September 28, 2015

**Test Jars showing leachate dosed with lime and ferric chloride:**



**Test Jars showing settled solids:**

